iTPC Project Overview

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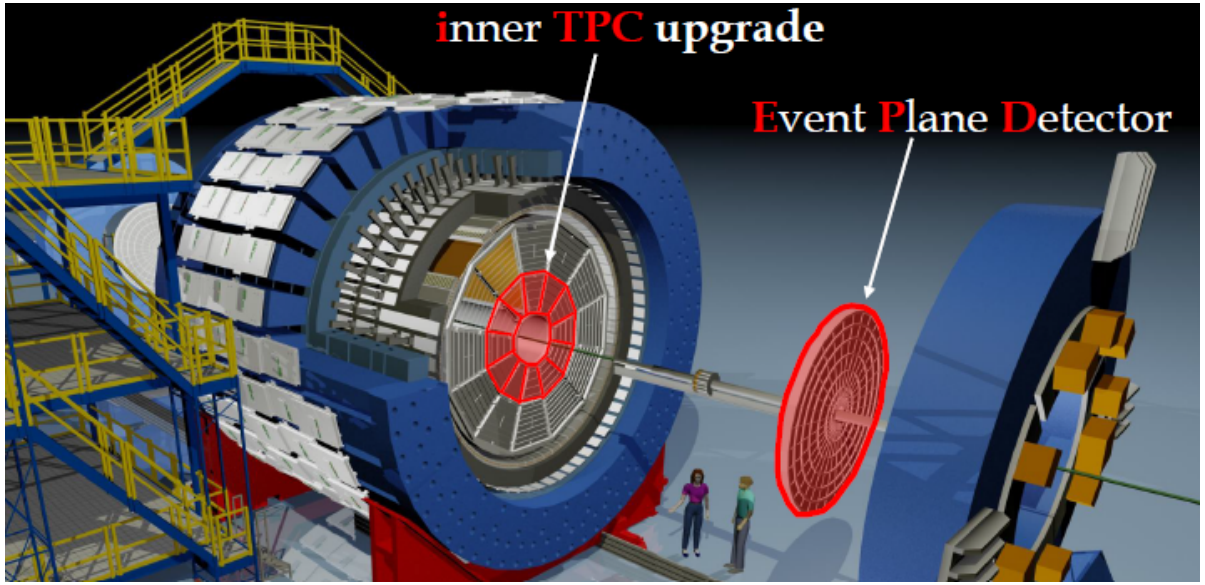
BNL



Key points to be conveyed

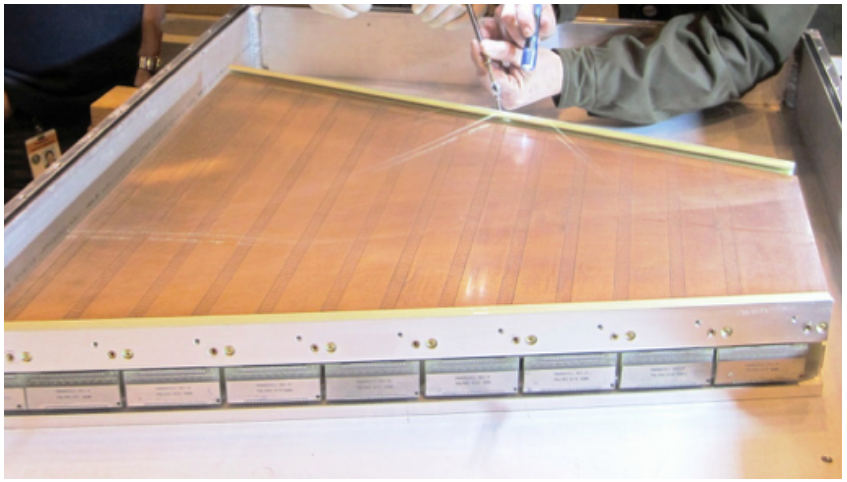
- What is the project
- What are the production plans
- Management
- Schedule & progress
- Discussion of the run-18 and installation
- KPP/UPP

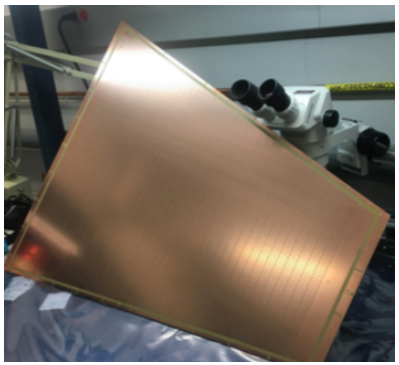
Upgrade key elements

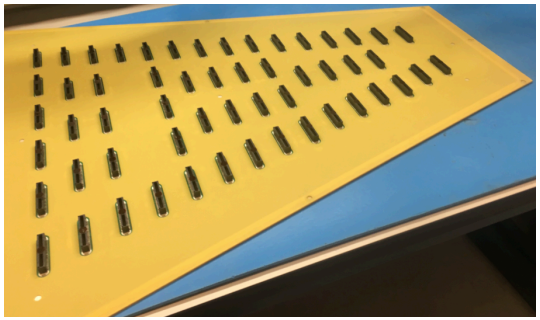
- Replacement of Inner Sectors (24)
  - Increase #padrows from 13 to 40.
  - Complete geometrical coverage
    - Mechanical Sector (Strongbacks)
    - Joining of padplanes with strongbacks
    - Assembly of MWPC on strongbacks
- This will improve
  - eta coverage from 1.0 to 1.5
  - P_t coverage from 0.20 -> 0.06 GeV/c
  - dE/dx

Strongback

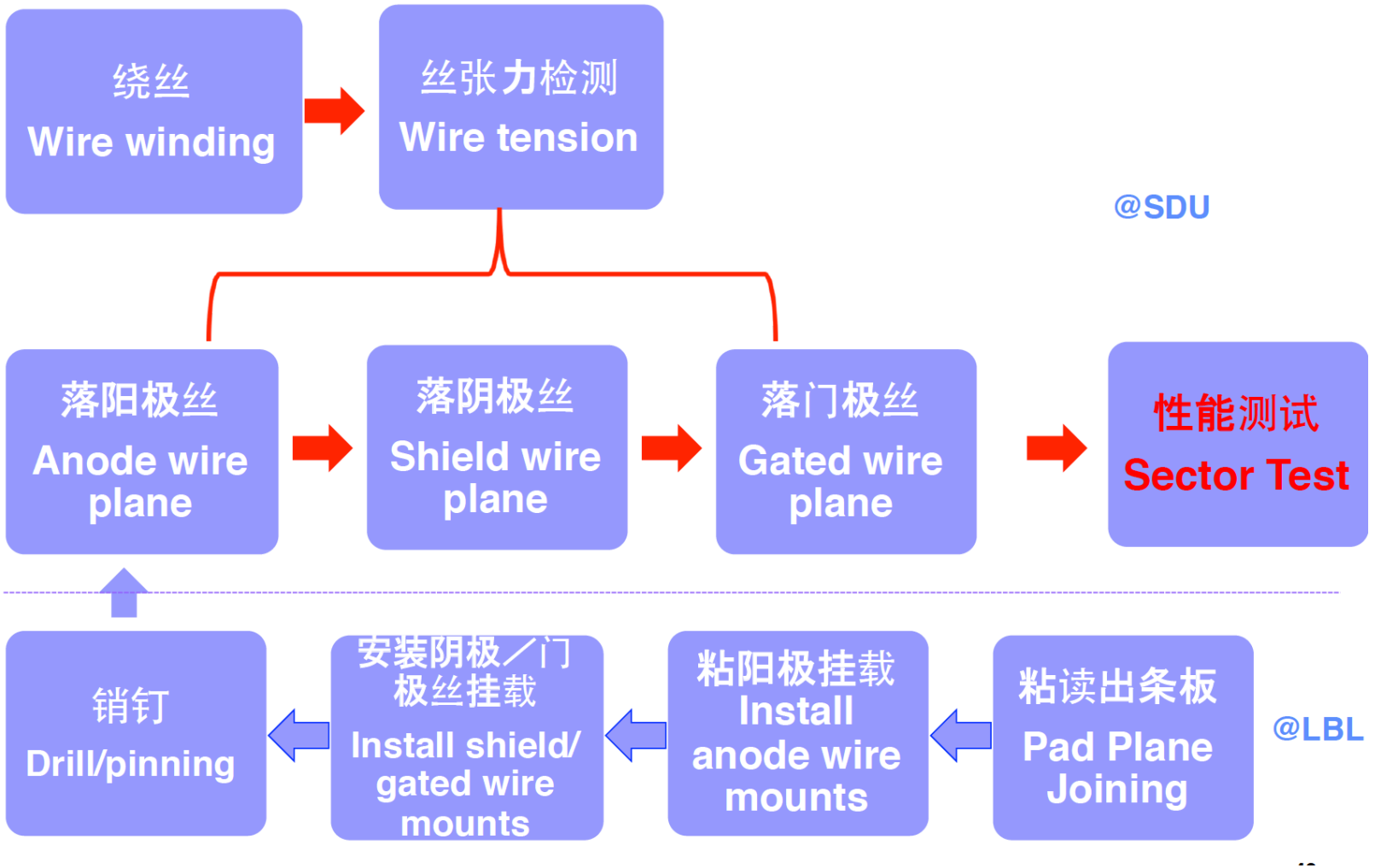
- Strongback, commercial fabrication
- Padplane , same # even/odd per connector as per recommendation







MWPC production



Electronics

- Electronics to handle increase of channels
  - Similar FEE layout and foot print as for existing DAQ1000 cards
  - Double #channels per FEE
  - RDO modules
  - DAQ PCs

Installation

- Installation in STAR
  - Replace existing inner 24 sector with new
    - Involves removing all electronics service, remove and insert new, reinstall services
  - Mount new electronics

- Commissioning

Timeline

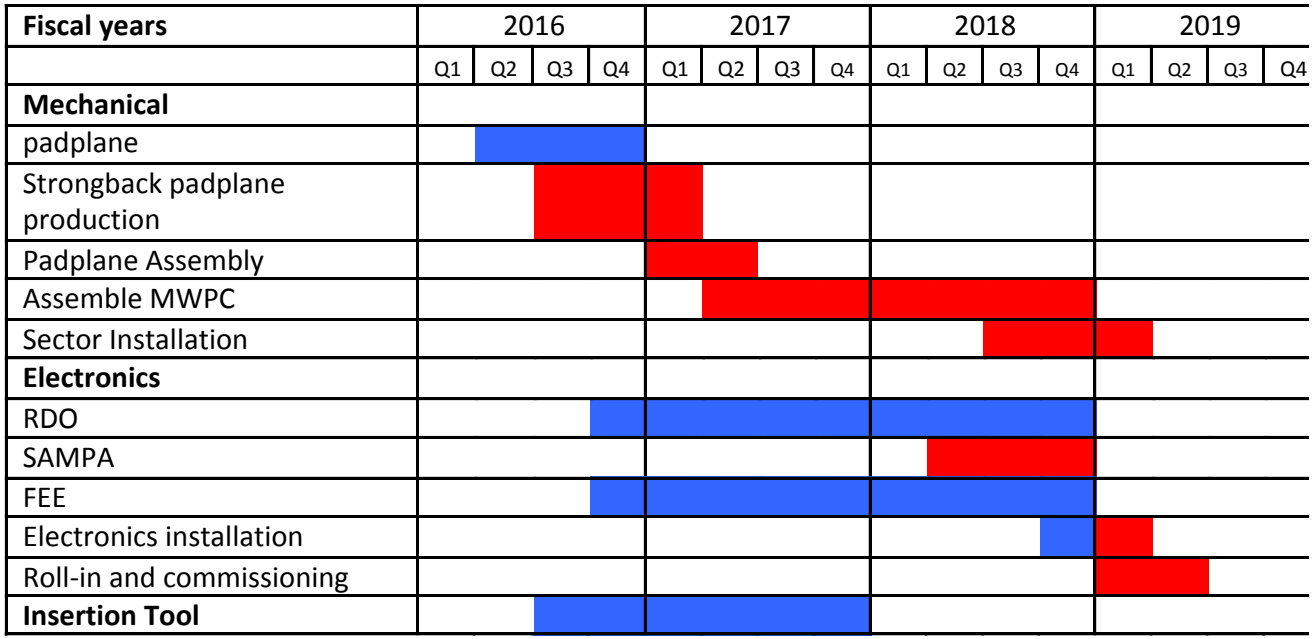
- Proposal several years ago (Late 2011)
- Internal STAR review Feb 5, 2015
- Proposal submitted and Physics Review by PAC in June 2015
- Follow-up discussion with ALD sufficient to proceed to technical review
- TDR completed and submitted to ALD November
- Risk assessment requested by ALD for TPC and iTPC submitted early December
- Directors review January; approval to proceed granted in February due to need to acquire long lead items (strongback, padplanes, setting contact with LBNL) ahead of the this review

Schedule Background

- The Start and length of run-18 directly impacts the start of run-19 since about 10 month is needed to roll in/out, replace of inner sectors, electronics, and commisioning
- A run-18 installation of a new inner sector will gain experience with methods and installation time required
- Currently run-18 is scheduled for 13 cryo weeks, and is coupled to CA-D LEReC R&D progress

Summary Schedule

- The WBS schedule has about 150 tasks



Current schedule has STAR ready for data taking March 1 2019, with ~1.5 month of commissioning. Single sector tested in run-18 Key goal of project is to have upgrade complete for Run-19.

Critical path goes through electronics path a) (SAMPA chip)

b) sector production installation, and testing & commissioning

Key Milestones

For this review the schedule was updated to reflect the actual status of production.

In particular the pad plane production has had issues, and delayed.

Mechanical		
	Pad plane PCB finalized	2/22/2016 (A)
	Pre-production pad plane complete	8/24/2016 (A)
	Strongback drawings finalized	1/28/2016 (A)
	Padplane production complete	12/16/2016
	First strongback ready for inspection	6/3/2016 (A)
	Strongback production complete	7/20/2016 (A)
	First strongbacks joined and shipped	1/30/2017
	MWPC production assembly starts	3/1/2017
	First 2 sectors at BNL	9/6/2017
	Last 6 sectors at BNL	10/3/2018
	Sector testing complete on floor	10/31/2018
Electronics		
	Receive SAMPA prototype	9/19/2016
	Prototype FEE ready for test in run-17	1/15/2017
	FEE preproduction complete	10/30/2017
	FEE production starts	6/12//2018
	RDO prototype complete	11/11/2016
	RDO final design signoff	6/25/2018
	RDO production complete	10/29/2018
	FEE assembled with SAMPA and ready for installation	10/25/2018
Installation		
	Start work of STAR detector in Assembly Hall after run-17	6/16/2017
	Insertion tooling tested and 1 sector replaced	11/3/2017
	Start sector Installation	5/16/18
	East installation complete	9/19/18
	West Sectors installation complete	12/12/2018
	Electronics complete Installed	1/30/2019
	Full system commissioning Complete	3/27/2019

+4 mo.

Cost to DOE

		FY16	FY17	FY18	Contingency	Total
Mgt	1.1	54	92	94	45	285
Padplane	1.2	105	0	0	17	122
Mechanics	1.3	865	264	15	238	1381
Installation	1.4	0.0	0.0	136	31	168
Electronics	1.5	19	277	1056	296	1648
Total DOE		**1,042**	**632**	**1301**	**628**	**3603**

- The NSF China contribution is not included
- The individual talks with in addition to technical aspects discuss Risk and schedule
- Overall detailed discussion in final talk

Progress

- Completed strongback design
- Initiated and completed strongback production
- Completed padplane design
- Completed padplane pre-production
  - Had production issues at the PCB factory, that had previous made a successful prototype pad plane, and procurement delays
- Initiated production of padplane (delayed)

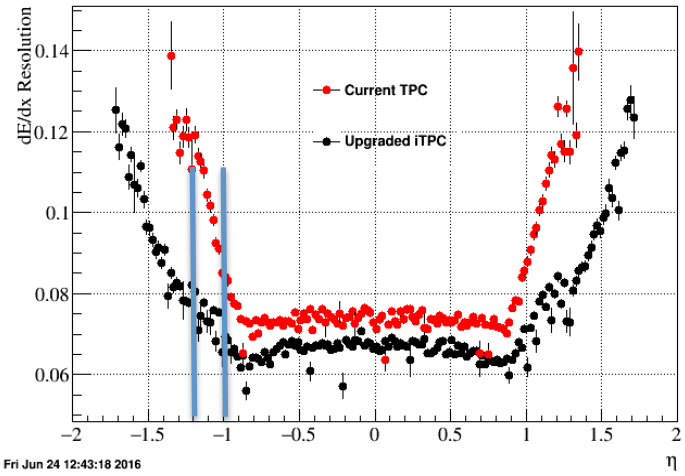
  => The pad-plane joining will start later than original planned; schedule shown today includes this delay

KPP/UPP

Parameter	Threshold value (KPP)	Ultimate value (UPP)
dE/dx resolution for pions/muons at BES-II energies	-	<6.9% $\|\eta\| \leq 0.1$ < 8.0% $1.0 < \|\eta\| \leq 1.2$
Gain at Nominal Voltage	~2000 +-5% at 1150 Volts	-
Tension on Anode Wires	0.50 Newtons ± 0.05	-
Fully working sectors delivered to BNL or repairable at BNL	22	-
HV sections operational	>95%	-
Compatible with STAR DAQ-1000 system	< 8%deadtime @ 1kHz and 30% @ 2 kHz from iTPC inner sectors	< 5% @ 1kHz and 20% @ 2 kHz dead time from iTPC at BES-II energies
Operational electronics fraction	Less than 8% dead channels per sector	Less than 3% dead channels for full system
Electronic Noise	< 2 ADC counts	-
Electronics gain Uniformity	<10%	

KPP/UPP

- The resolution of the dE/dx is a critical parameter for the performance of the TPC The upgraded TPC with the inner sectors will provide part of the total dE/dx signal. For $|\eta| > 1$ the inner sectors are the dominating contributor to the dE/dx and considerable better than the current TPC. This can be measured with beam and be demonstrated after several months of calibration work.
- The KPP are measurements that needs to be fulfilled to achieve the performance for the UPP
- Will come back to this in more detail



Talks to come

- Strongback and padplanes
- Wirechamber production
- Electronics
- Installation
- Cost, Schedule, Management, KPP/UPP

Documents provided

The list of documents uploaded

- Charge letter, review members
- Agenda
- Technical Design Report (November 2015)
- Link to talks from January 2016 Directors review of iTPC project
- Review report from Directors review in January 2016
- Follow up by STAR to report February 2016
- Project Management Plan (draft with updates following comments from the NP office)
- Shandong University-STAR research agreement
- Risk assessment TPC and iTPC (November 2015)
- Report from "Task Force on RHIC operations" July – particular recommendation on page 2-3
- PAC report from June 2016 – comments on iTPC page 12-13
- PAC 2015 presentation on iTPC
- PAC 2015 recommendation on iTPC (Page 11-12)
- STAR response to 2015 PAC recommendations – submitted to ALD September 2015
- WBS schedule